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# CHANGES IN FOREST CONDITIONS 1936-1949 NORTH CENTRAL MINNESOTA AND UPPER PENINSULA OF MICHIGAN

## (A PRELIMINARY ANALYSIS)

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U. S. Department of Agriculture, Forest Service
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# CHANGES IN FOREST CONDITIONS, 1936-1949 NORTH CENTRAL MINNESOTA AND UPPER PENINSULA OF MICHIGAN (A PRELIMINARY ANALYSIS)

By R. N. Cunningham, Forest Economist

## INTRODUCTION

What has happened to the forests of the Lake States as a result of the abnormally heavy cutting during and since World War II and also from the stimulus of improved fire protection and other measures of forest management? This is a question of great interest to many foresters, conservationists, and others concerned with the timber resource.

In Michigan and Minnesota the current Forest Survey has progressed sufficiently far to offer a basis for preliminary appraisal in two districts: The central pine district of Minnesota and the west half of the Upper Peninsula of Michigan. Here are available the results of a field survey completed late in 1935 and also tabulations for most of the counties and fractional tracts making up the districts, from resurveys made between 1947 and 1951.2/ The elapsed time between surveys was roughly 13 years as an average.

There are several differences in the way the two surveys were made (see page 20 in Appendix), but it is believed that the figures convey information of real significance and should help to give an understanding of forestry trends which may be under way. It must be borne in mind, of course, that the two districts are not necessarily representative of the region as a whole.

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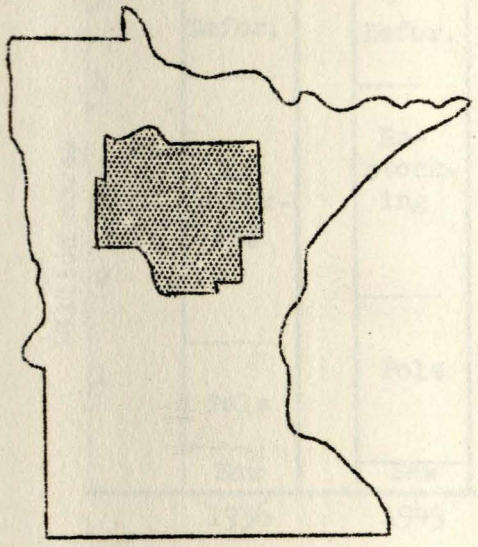
1/ Maintained by the U. S. Department of Agriculture, Forest Service, in cooperation with the University of Minnesota at University Farm, St. Paul, Minnesota.

2/ The author is indebted to Clarence Chase and others of the Survey group at the Lake States Station for compilation of recent data for the Upper Peninsula of Michigan; also to Lynn Sandberg, J. Marvin Kittelson, and others of the Iron Range Resources group for preliminary Minnesota survey figures.

CENTRAL PINE DISTRICT - MINNESOTA

Background

Location of District



The district has a gross land area of 7,206,000 acres, of which 5,285,000 acres (73 percent) were classified as forest in 1936. For comparability, the same total acreage is maintained in this analysis.3/

The original forest here was primarily pine, running out to prairie on the west and into spruce bogs on the north. Poor hardwoods, maple-basswood, oak, and ash-elm occurred spottily in the north and more or less continually around the southern margin.

Currently the major types are aspen, jack pine, swamp conifers (black spruce, tamarack, white cedar), northern hardwoods, ash-elm, and scrubby oak. Valuable old-growth is confined mainly to public preserves and scattered groves in various ownerships.

The district contains one national forest, portions of two major Indian Reservations, 16 state forests or parks, and a number of recently organized county forests.

The district supports two pulp mills and several hundred smaller industries, and in addition exports quantities of wood to other parts of Minnesota and to Wisconsin.

The first survey was made during the depression when timber industries were relatively inactive. Cutting for lumber and pulp began to accelerate in 1937 and was boosted in 1939-40 by demand for grain bins. During the war, cutting was very heavy and since 1946 has continued strong in most areas.

The district has a thriving tourist industry based upon forests and waters. It has some watershed significance in that it surrounds the headwaters of the Mississippi River and supplies water for urban consumption, for power, for navigation, and for limited irrigation.

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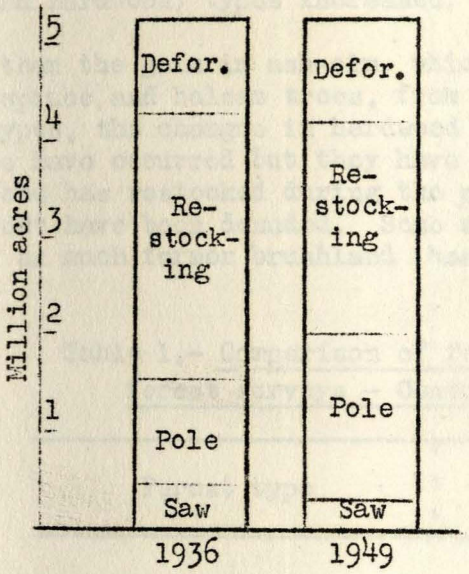
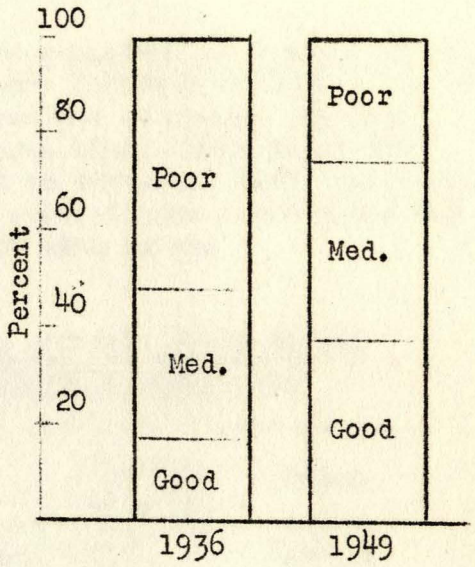
3/ New survey reports include more deforested swamp land in the commercial forest category than the original survey did. To facilitate comparisons, the excess has been eliminated arbitrarily.

Outstanding changes in Forest Conditions, 1936-1949
Central Pine District of Minnesota

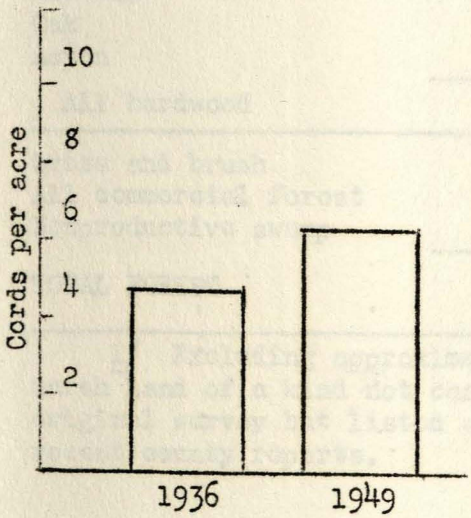
Stand size class



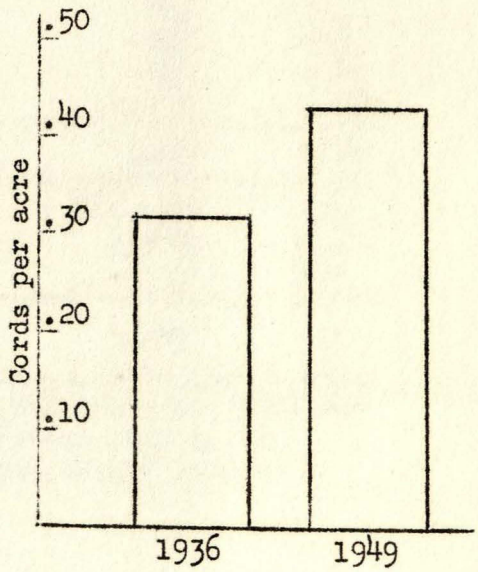

Density of stocking
(Seedling and sapling areas)




Average volume (on stocked area)




Average annual growth



## Type Changes in Central Pine District

Softwood types declined nearly 10 percent in area between the 1936 and 1949 surveys (table 1). Percentagewise, the greatest loss was in the spruce-balsam and the white and red pine types. Grass, brush, and the ash-elm (lowland hardwood) types increased.

Other than the gain in ash-elm, which could be explained by removal of white pine, spruce, and balsam trees, from mixed stands formerly classified as softwood types, the changes in hardwood acreage are not striking. No doubt changes have occurred but they have been compensating. Some grass and brushland has restocked during the period but on the other hand, large areas of forest have been denuded. Some aspen has evolved into other types but nearly as much former brushland has restocked with aspen.

Table 1.- Comparison of forest type acreages shown by two forest surveys - Central Pine District, Minnesota

| Forest type | Original survey | Current resurvey | Change |
|---|---|---|---|
| | Thousand acres | | Percent |
| White and red pine | 152 | 123 | -19 |
| Jack pine | 481 | 465 | - 3 |
| Spruce-balsam fir | 244 | 189 | -23 |
| Swamp conifer | 465 | 438 | - 6 |
| All softwood | 1,342 | 1,215 | - 9½ |
| Northern hardwood | 302 | 308 | + 2 |
| Ash-elm | 199 | 296 | +49 |
| Oak | 161 | 165 | + 2½ |
| Aspen | 2,314 | 2,254 | - 2½ |
| All hardwood | 2,976 | 3,023 | + 1½ |
| Grass and brush | 891 | 1/ 1,010 | +13 |
| All commercial forest | 5,209 | 5,248 | + 1 |
| Nonproductive swamp | 76 | 37 | -51 |
| TOTAL FOREST | 5,285 | 5,285 | 0 |

1/ Excluding approximately 500,000 acres of grass and marsh land of a kind not considered forest land in the original survey but listed as potential forest land in recent county reports.

## Changes in Stand-Size Class

The most notable changes between surveys were:

1. A drop of more than 50 percent in area of large saw timber occurring largely in the softwood types.

2. A decline of nearly 23 percent in small saw timber - less significant because some of the change in aspen is a matter of classification. (Old survey classified aspen as saw timber down to a 9.0 inches d.b.h., whereas current surveys cut off at 11.0 inches. As a result, few aspen stands now qualify as saw timber.)

3. An increase of more than 50 percent in pole timber area. Apparently large acreages of aspen and other hardwood saplings have graduated into pole-size during the interim.

4. A reduction in area of seedlings and saplings.

Table 2.- Stand-size class acreages in two surveys
Central Pine District, Minnesota

| Forest types | Survey | Stand-size class | | | | |
|---|---|---|---|---|---|---|
| | | Saw timber | | Pole timber | Seedlings and saplings | All classes 1/ |
| | | Large | Small | | | |
| | | Thousand acres | | | | |
| Pine | Old | 47 | 92 | 250 | 244 | 633 |
| | Now | 18 | 109 | 216 | 245 | 588 |
| Other softwood | Old | 7 | 52 | 248 | 402 | 709 |
| | Now | 1 | 20 | 293 | 313 | 627 |
| Aspen-birch | Old | 4 | 132 | 491 | 1,687 | 2,314 |
| | Now | 2 | 47 | 888 | 1,317 | 2,254 |
| Other hardwood | Old | 9 | 97 | 142 | 414 | 662 |
| | Now | 10 | 112 | 356 | 291 | 769 |
| All types | Old | 67 | 373 | 1,131 | 2,747 | 4,318 |
| | Now | 31 | 288 | 1,753 | 2,166 | 4,238 |

1/ Excluding deforested and non-commercial area.

## Changes in Density

In both surveys, stands were classified as good, medium, or poor density under essentially the same standards. Comparison of figures (table 3) indicates a definite improvement over the period.

For pole stands, the improvement is consistent throughout, although in jack pine the change is not large presumably because of the heavy cutting to which it has been subjected. The over-all density of pole stands increased from 39 percent of full stocking 4/ on the old survey to 47 percent in the new.

On restocking areas, all types except white and red pine show improvement. Over-all density increased from 44 percent in the old survey to 59 percent in the new.

Table 3.- Comparison of stand density, 1936 and 1949, Central Pine District, Minnesota

| Forest types | Stocking | | | | | |
|---|---|---|---|---|---|---|
| | Old survey | | | New survey | | |
| | Good | Medium | Poor | Good | Medium | Poor |
| | Percentage | | | | | |
| **POLE STANDS** | | | | | | |
| Pine | 18 | 30 | 52 | 20 | 34 | 46 |
| Other softwood | 10 | 25 | 65 | 27 | 35 | 38 |
| Aspen | 11 | 25 | 64 | 18 | 38 | 44 |
| Other hardwood | 2 | 18 | 80 | 12 | 34 | 54 |
| All types | 11 | 26 | 63 | 19 | 36 | 45 |
| **RESTOCKING AREAS** | | | | | | |
| Pine | 20 | 28 | 52 | 24 | 33 | 43 |
| Other softwood | 21 | 33 | 46 | 38 | 32 | 30 |
| Aspen | 17 | 32 | 51 | 44 | 37 | 19 |
| Other hardwood | 9 | 28 | 63 | 24 | 42 | 34 |
| All types | 17 | 31 | 52 | 38 | 37 | 25 |

4/ Using a weight of 85 percent for good stocking, 55 percent for medium, and 25 percent for poor.

## Changes in Volume

The new survey has not progressed to the point where total volumes can be compared. In the first four counties reported, however, volumes per acre averaged generally higher than in the earlier survey, specifically:

| | Average volume per acre* | |
|---|---|---|
| | Saw timber (Bd.ft., Int.) | Total volume (Cords) |
| Old survey | 680 | 4.7 |
| New survey | | |
| Aitkin County | 600 | 5.1 |
| Crow Wing County | 730 | 5.6 |
| Clearwater County | 630 | 7.0 |
| Cass County | 1,160 | 7.3 |
| Four counties | 840 | 6.3 |

* On productive forest land only, excluding deforested area and stagnant bogs.

The increase in volume per acre, insofar as the four counties are concerned, occurred consistently in all major types.

## Changes in Rate of Growth

Growth estimates for the first four Minnesota counties covered in the new survey indicated substantial increase over the previous estimate for the district as a whole.

| | Average annual growth per acre* | |
|---|---|---|
| | Saw timber (Bd.ft., Int.) | Total volume (Cords) |
| Old survey | 35 | .32 |
| New survey | | |
| Aitkin County | 54 | .46 |
| Crow Wing County | 75 | .33 |
| Clearwater County | 71 | .40 |
| Cass County | 81 | .47 |
| Four counties | 71 | .43 |

* Productive forest area only, excluding deforested land and stagnant bog.

Saw-timber growth increased in all major type groups. Growth in total cubic volume (recorded in cords) declined in the pine group but increased in all other groups.

## Change in Allowable Cut

In the earlier survey it was estimated that the Central Pine District forests, with good management, could support an annual cut of 115,000 M board feet, or 39,400 M cubic feet. This is equivalent to 26,600 M board feet or 114,000 cords per million acres of productive forest area. Recent surveys indicate a larger possible cut as follows:

| | Allowable annual cut per million acres of productive forest* | |
|---|---|---|
| | Saw timber (M bd.ft., Int.) | Total volume (Cords) |
| Old survey | 26,600 | 114,000 |
| New survey | | |
| Aitkin County | 22,900 | 144,000 |
| Crow Wing County | 37,000 | 200,000 |
| Clearwater County | 43,100 | 357,000 |
| Cass County | 46,100 | 252,000 |
| Four counties | 37,000 | 228,000 |

* Noncommercial and deforested area excluded.

The increase in allowable cut is almost entirely in aspen and other hardwoods.

## Changes in Rate of Cutting

Cutting drain on the original survey was expressed as the normal (pre-depression average) rate of cutting for mills and other wood users active at the time of the survey. This was substantially higher than actual rate of cutting in 1935.

Drain in recent years has been the estimated actual cut for specified years.

The recent rate of cutting, judging by data from the four counties, is less than previously reported in saw-timber material but greater in total cubic volume.

| | Estimated annual drain per million acres productive forest land | |
|---|---|---|
| | Saw timber (M bd.ft., Int.) | Total volume (Cords) |
| Old survey (Est. 1936-45) | 26,800 | 140,000 |
| New survey | | |
| Aitkin County (1946) | 21,600 | 118,000 |
| Crow Wing County (1946) | 26,500 | 251,000 |
| Clearwater County (1946) | 29,300 | 322,000 |
| Cass County (1949) | 16,800 | 139,000 |
| Four counties | 21,800 | 179,000 |

## Changes in Drain vs. Allowable Cut Ratio

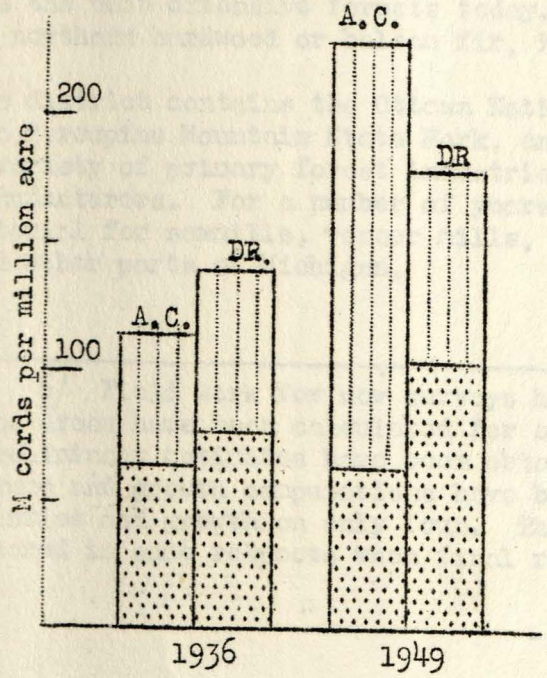
The first survey showed drain about equal to allowable cut in saw timber material, but about 23 percent greater than allowable cut in terms of total volume. No important difference was shown for softwoods and hardwoods.

The recent resurveys for four counties indicate that overall drain is but 59 percent of allowable cut in saw-timber material and 78 percent in total volume.

In both cases, the allowable cut was predicated on good cutting practices (including considerable thinning and improvement cutting in the more recent estimate); and also upon close utilization with the cut spread over both accessible and inaccessible areas. It exaggerates the cut permissible with practices now prevailing in the district.

| | Drain as percentage of allowable cut | |
|---|---|---|
| | Old survey | New survey* |
| Saw timber | | |
| Softwoods | 97 | 80 |
| Hardwoods | 106 | 46 |
| All species | 101 | 59 |
| Total volume | | |
| Softwoods | 122 | 164 |
| Hardwoods | 124 | 45 |
| All species | 123 | 78 |

* Based upon four counties: Aitkin, Crow Wing, Clearwater, and Cass.




The recent surveys indicate that over-all drain is conservative; but the drain on softwoods is excessive, while hardwoods are not being used in large enough quantities.

Records for individual counties show drain-allowable cut ratios more favorable in some than others. Also they usually show over-cutting on private lands, under-cutting on federal, state, and county lands.

Legend

A.C. = Allowable Cut

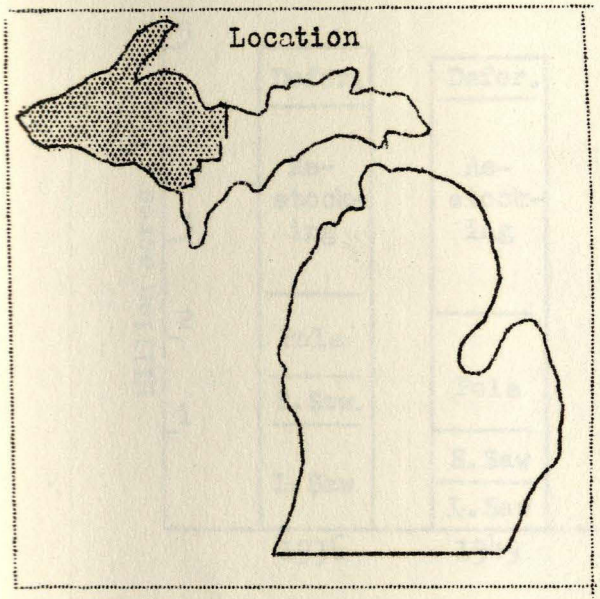
DR. = Drain

Softwood

Hardwood

## WEST HALF OF UPPER PENINSULA OF MICHIGAN

### Background




The district is made up of eight counties and has a total land area of 5,571,000 acres, of which approximately 4,986,000, or almost 90 percent was classified as forest in 1936. Current surveys show 2 percent loss forest area or 4,880,000 acres.6/

The original forest was mainly northern hardwood with hemlock and pine in mixture. Sandy pine lands comparable to the Central Pine District of Minnesota occurred but were not extensive. Conglomerate mixtures of lowland hardwoods and conifers occupied poorly drained lands, amounting to about one-sixth of the total area, while black spruce, tamarack, and cedar covered the one-tenth of the land in bogs.

Second-growth northern hardwoods -- minus most of the pine and hemlock -- are the most extensive forests today. Aspen, commonly with an understory of northern hardwood or balsam fir, is second in area.

The district contains the Ottawa National Forest, Isle Royale National Park, the Porcupine Mountain State Park, and several lesser public areas. It has a variety of primary forest industries but relatively few secondary timber manufacturers. For a number of years it has been a major source of raw material for sawmills, veneer mills, pulp mills, and so forth, in Wisconsin and other parts of Michigan.

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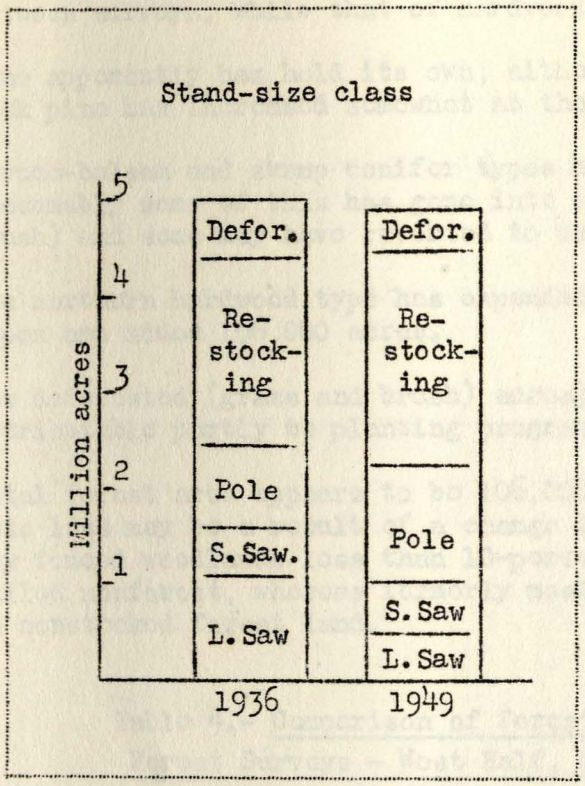
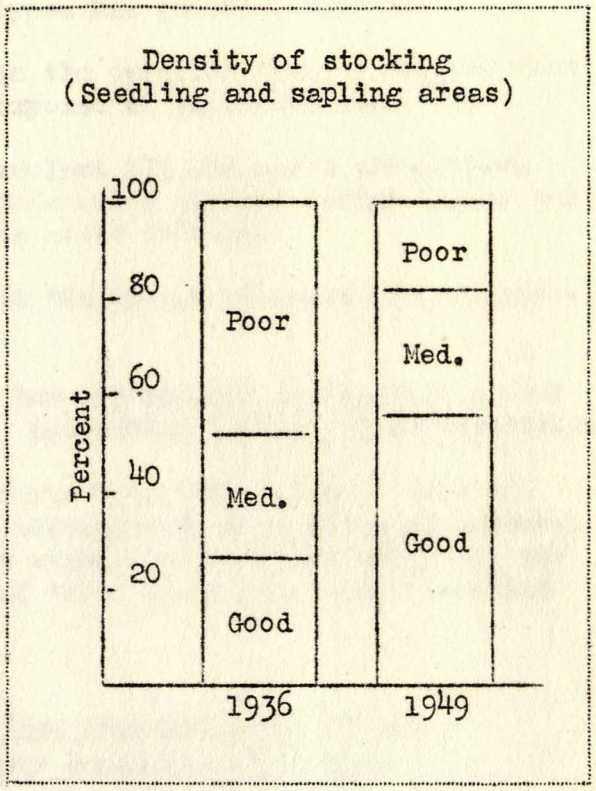
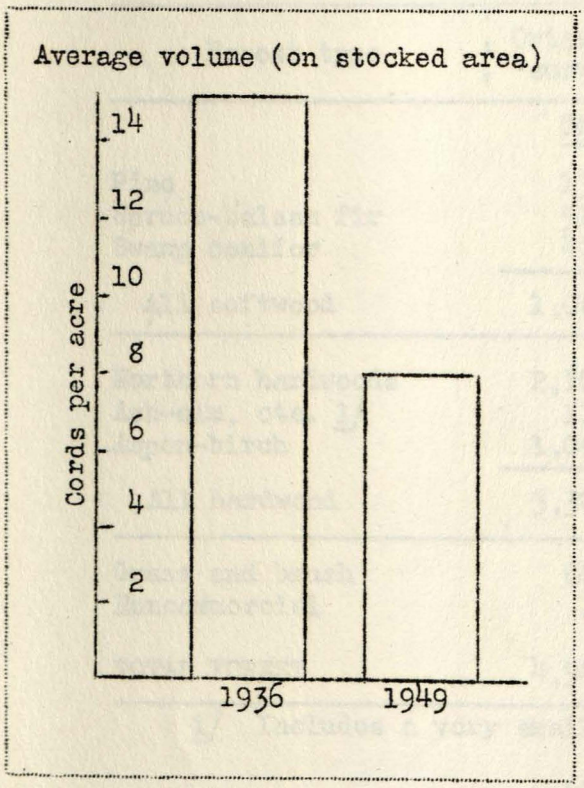
6/ Field work for new surveys has been completed in all counties, and type areas have been calculated for all lands outside of the national forest (preliminary estimates have been obtained for the national forest area). Volume and growth computations have been made on only five of the eight counties and growth on only four. Thus the figures presented here may be altered in some respects when final reports are prepared.

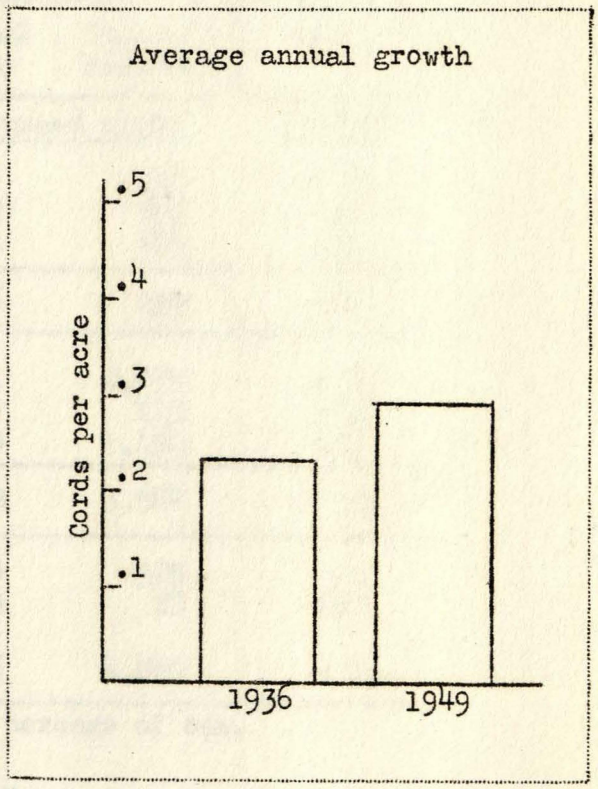
## Outstanding changes in Forest Conditions, 1936-1949

## Western Half of Upper Peninsula of Michigan



## Type Changes in the West Half of the Upper Peninsula

Acreage of softwood types has declined about 16 percent during the period between surveys, while that of hardwood types has gained (table 4).

Pine apparently has held its own, although the detailed figures suggest that jack pine has increased somewhat at the expense of white and red pine.

Spruce-balsam and swamp conifer types have lost 175,000 acres altogether. Presumably some of this has gone into a deforested classification (grass and brush) and some may have reverted to aspen after cutting.

The northern hardwood type has expanded to the extent of about 178,000 acres. Aspen has added 106,000 acres.

The deforested (grass and brush) acreage has shrunk very distinctly, a fact attributable partly to planting programs, but mainly to natural reforestation.

Total forest area appears to be 106,000 acres less than before. Some of this loss may be a result of a change in classification of woodland pasture. Any fenced woodlands less than 10-percent stocked with forest trees are now called nonforest, whereas formerly most of these woodlands were classified as nonstocked forest land.

Table 4.- Comparison of forest type acreages shown by two Forest Surveys - West Half, Upper Peninsula of Michigan

| Forest type | Original survey | Current resurvey | Change |
|---|---|---|---|
| | Thousand acres | | Percent |
| Pine | 131 | 133 | + 1½ |
| Spruce-balsam fir | 512 | 395 | -23 |
| Swamp conifer | 423 | 365 | -14 |
| All softwood | 1,066 | 893 | -16 |
| Northern hardwoods | 2,101 | 2,279 | + 8½ |
| Ash-elm, etc. 1/ | 117 | 115 | - 1½ |
| Aspen-birch | 1,084 | 1,190 | +10 |
| All hardwood | 3,302 | 3,584 | + 8½ |
| Grass and brush | 604 | 375 | -38 |
| Noncommercial | 14 | 28 | +50 |
| TOTAL FOREST | 4,986 | 4,880 | - 2 |

1/ Includes a very small acreage of oak.

## Changes in Stand-Size Class

Probably the most significant change in the Upper Peninsula picture has been the 50+-percent reduction in area of large saw timber (shown in table 5). This clearly reflects the results of abnormally heavy logging during most of the period between surveys.

Another interesting point is the evidence of movement of stands from sapling into pole-timber size. This is especially notable in aspen, where pole-timber area increased 57 percent, and in the other hardwood types where it increased 63 percent.

In the hardwood types again there is evidence of movement from pole-timber to small saw-timber size. Small saw-timber area increased 37 percent between surveys. Some of this came from partially logged old-growth, but some unquestionably came as a result of growth.

Table 5.- Comparison of acreage by type group and size class, 1936-49
West Half, Upper Peninsula of Michigan

| Forest types | Survey | Stand-size class | | | | |
|---|---|---|---|---|---|---|
| | | Saw timber | | Pole timber | Seedlings and saplings | All 1/ classes |
| | | Large | Small | | | |
| | | Thousand acres | | | | |
| Pine | Old | 29 | 30 | 35 | 37 | 131 |
| | New | 14 | 27 | 33 | 59 | 133 |
| Other softwood | Old | 41 | 167 | 272 | 469 | 949 |
| | New | 4 | 72 | 293 | 391 | 760 |
| Aspen-birch | Old | 3 | 19 | 289 | 773 | 1,084 |
| | New | 1 | 33 | 454 | 702 | 1,190 |
| Other hardwood | Old | 1,020 | 287 | 256 | 655 | 2,218 |
| | New | 499 | 394 | 417 | 1,084 | 2,394 |
| All types | Old | 1,093 | 503 | 852 | 1,934 | 4,382 |
| | New | 518 | 526 | 1,197 | 2,236 | 4,477 |

1/ Excluding deforested and noncommercial area.

## Changes in Density

Very encouraging evidence of improvement in younger timber stands is obtained from comparison of stand densities in the two surveys (table 6).

In pole-timber stands of all types, the proportion of poorly stocked stands has declined sharply. The shift has been least in the other softwood (spruce-fir and swamp conifer) types, due no doubt to heavy cutting for pulp on the one hand and relatively slow growth on the other. Even in these types, however, some improvement can be noticed.

In seedling and sapling stands, the evidence of "thickening" is very clear indeed. The presumption is that this has occurred as a result of improved fire protection, some planting, and more forest area under management. Because it is in very young stands, the improvement may not have any appreciable effect on timber yields in the immediate future, but it promises more for later periods.

Table 6.- Comparison of stand densities, 1936-1949, in pole-timber and seedling and sapling stands - West Half, Upper Peninsula of Michigan

| Forest types | Density classification | | | | | |
|---|---|---|---|---|---|---|
| | Old survey | | | New survey | | |
| | Good | Medium | Poor | Good | Medium | Poor |
| | Percentage | | | | | |
| **POLE TIMBER STANDS** | | | | | | |
| Pine | 9 | 23 | 68 | 15 | 40 | 45 |
| Other softwood | 16 | 29 | 55 | 11 | 46 | 43 |
| Aspen | 6 | 28 | 66 | 17 | 38 | 45 |
| Other hardwood | 9 | 22 | 69 | 16 | 35 | 49 |
| All types | 10 | 26 | 64 | 15 | 39 | 46 |
| **SEEDLING AND SAPLING STANDS** | | | | | | |
| Pine | 8 | 16 | 76 | 32 | 24 | 44 |
| Other softwood | 27 | 23 | 50 | 31 | 32 | 37 |
| Aspen | 22 | 26 | 52 | 41 | 36 | 23 |
| Other hardwood | 35 | 25 | 40 | 76 | 18 | 6 |
| All types | 27 | 25 | 48 | 56 | 26 | 18 |

## Changes in Timber Volume

Merchantable timber volume has declined 40 to 50 percent between surveys, despite the fact that per-acre volumes have increased in most of the younger stands. The decline is attributable mainly to liquidation of old-growth forests.

Although per-acre volumes have increased in practically all size classes of the softwoods, the over-all volume in pine types is about one-third less than before, and that in other softwood types about one-eighth less (table 7).

In most hardwood types, the heavy cutting plus changes in definition (elimination of 10-inch trees from saw timber and elimination of limbwood from total volume in the second survey) have resulted in drastic reduction in over-all volume. In the case of aspen, however, the over-all volume has practically doubled.

## Changes in Annual Growth Rate

A preliminary growth estimate for the west half of the Upper Peninsula of Michigan shows about one-fourth greater growth than in 1936 in terms of total cubic volume. It averages .29 cords per stocked acre, compared with .23 cords previously. In terms of saw timber, present growth is one-sixth greater -- 52 board feet per stocked acre versus 45 board feet.

Softwood types are growing much more rapidly than previously estimated on a per-acre basis, but acreages have shrunk.

Hardwood types appear to be growing faster in cubic volume but, except for aspen, they have smaller board-foot growth per acre. The decline here may be due mainly to changed methods of measurement but probably reflects also some depreciation in average quality of stands.

Table 7.- Comparison of volume per acre by type groups and size classes, 1936-49 west half, Upper Peninsula of Michigan

SAW-TIMBER VOLUME PER ACRE - Board Feet

| Forest type group | All stands | | Large saw-timber stands | | Small saw-timber stands | | Pole-timber stands | | Seedling and sapling stands | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Old | New | Old | New | Old | New | Old | New | Old | New |
| Pine | 3,230 | 2,200 | 9,400 | 9,700 | 3,800 | 5,300 | 950 | 820 | 80 | 190 |
| Other softwoods | 1,220 | 1,060 | 5,720 | 6,000 | 3,580 | 4,740 | 910 | 1,030 | 170 | 360 |
| Aspen-birch | 220 | 470 | 7,890 | 3,000 | 3,140 | 3,090 | 350 | 690 | 60 | 200 |
| Other hardwoods | 6,180 | 2,950 | 11,700 | 8,100 | 4,140 | 4,200 | 930 | 1,180 | 540 | 800 |
| All types | 3,540 | 1,950 | 11,380 | 8,100 | 3,900 | 4,200 | 730 | 950 | 250 | 520 |

TOTAL VOLUME PER ACRE - Cords

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Pine | 10.8 | 9.5 | 32.8 | 29.6 | 13.7 | 15.5 | 6.0 | 9.8 | 0.8 | 1.8 |
| Other softwoods | 9.3 | 7.3 | 29.6 | 22.1 | 23.0 | 20.3 | 10.4 | 10.6 | 2.1 | 2.4 |
| Aspen-birch | 2.5 | 4.8 | 33.4 | 28.0 | 18.8 | 12.7 | 6.4 | 8.0 | 0.5 | 2.4 |
| Other hardwoods | 24.0 | 9.7 | 41.8 | 20.1 | 21.1 | 13.0 | 9.0 | 9.4 | 3.2 | 3.8 |
| All types | 15.1 | 8.0 | 41.0 | 20.5 | 21.4 | 14.1 | 8.5 | 9.2 | 1.8 | 3.1 |

Table 8.- Comparison of annual growth per acre by type groups and stand-size classes, 1936-49, west half, Upper Peninsula of Michigan

SAW TIMBER - Board Feet

| Forest type group | All stands | | Saw-timber stands | | Pole-timber stands | | Seedling and sapling stands | |
|---|---|---|---|---|---|---|---|---|
| | Old | New | Old | New | Old | New | Old | New |
| Pine | 73 | 114 | 107 | 206 | 75 | 160 | 15 | 24 |
| Other softwoods | 21 | 71 | 46 | 135 | 58 | 125 | 9 | 17 |
| Aspen-birch | 21 | 36 | 168 | 96 | 51 | 78 | 5 | 6 |
| Other hardwoods | 61 | 50 | 79 | 67 | 59 | 82 | 26 | 24 |
| All types | 45 | 52 | 77 | 78 | 57 | 93 | 13 | 17 |

TOTAL GROWTH - Cords

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Pine | .17 | .39 | .15 | .50 | .32 | .48 | .11 | .26 |
| Other softwoods | .14 | .25 | .06 | .48 | .18 | .41 | .14 | .09 |
| Aspen-birch | .28 | .33 | .29 | .29 | .58 | .45 | .18 | .26 |
| Other hardwood | .25 | .27 | .18 | .21 | .31 | .40 | .37 | .28 |
| All types | .23 | .29 | .17 | .24 | .36 | .42 | .23 | .24 |

## SUMMARY AND CONCLUSIONS

A comparison of figures from the original Forest Survey (1935-37) with those from recent resurveys in two Minnesota and Michigan districts gives some good clues concerning trends in Lake States forest conditions. Because the survey figures in both instances are based upon rather light samples, and because some of the figures from the resurvey are still tentative, firm conclusions cannot be drawn from the comparisons. However, indications are as follows:

1. Acreage of softwood types declined rather sharply during the 13-year period between surveys -- nearly 10 percent in the Minnesota Central Pine District and 16 percent in the western part of the Upper Peninsula of Michigan.

2. Deforested area shrunk in Michigan where northern hardwoods are the predominant natural cover. It increased in Minnesota where pine and swamp types are involved.

3. The acreage of aspen changed little in either district.

4. The area of large saw timber was reduced by half.

5. Density of stocking improved substantially, at least in seedling, sapling, and pole stands.

6. Forests now have a higher average volume per acre than before in four Minnesota counties tested. In Michigan, however, heavy liquidation of old-growth timber more than offset the improvement in smaller size classes, and resulted in a sharp decline in over-all volume.

7. Average annual growth per acre increased both in terms of board feet and total volume.

8. The allowable annual cut now is as large or larger than in 1936, but should include a larger proportion of hardwoods and should be obtained more generally from improvement cuttings and thinnings.

9. Current drain in the Minnesota district, while less than previously reported in terms of saw-timber material, is greater in terms of total volume. It is 64 percent greater than allowable cut in the case of softwood timber, but falls more than 50 percent short of allowable cut in hardwoods.

These indications seem to support the general conclusion that the period 1936-49 was a very destructive one as regards mature and merchantable timber, but at the same time one which permitted substantial improvement in condition of young growth. It saw some further deterioration in type

proportions (softwood versus hardwood) and in proportion of stand-size classes (merchantable versus young growth). But it saw improvement in stand densities and in current and prospective timber growth.

Fuller presentation of the new survey data, together with recommendations for remedial action are being published in a series of county reports -- in Minnesota by the Office of Iron Range Resources and Rehabilitation, St. Paul, and in Michigan by the Department of Conservation, Lansing. An analysis of the situation, state wide, will be published by the Lake States Station on completion of the resurveys in Minnesota and Michigan.

## APPENDIX

### Comparability of the Old and New Surveys

Without going into full details as to methods and specifications, it is necessary to call attention to certain points which have a bearing upon the validity of the comparisons between the original surveys and the resurveys. Although there are several differences between the surveys it is believed that the figures convey information of real significance and shed light on forestry trends which may be under way.

1. Both surveys were sampling propositions. The first followed a line plot system with 1/5-acre plots at 10-chain intervals on lines 10 miles apart. Each plot represented about 800 acres of land. The current survey is based upon nine 40-acre sample blocks per township. Each block represents 2,560 acres of land.1/ These sampling intensities provide area estimates with fairly small standard errors as regards total forest area, and of moderate magnitude for major types and condition classes where these are distributed over large districts such as those under consideration here. They do not provide a basis for hair-splitting comparisons of small types or conditions; for example, conditions covering less than 10,000 acres.

2. The Central Pine District in Minnesota as defined in the original survey did not exactly follow county lines. It has been necessary to make some minor adjustment, with the help of type maps, to make the data from current county-unit surveys correspond with the original district. No adjustments were needed in Michigan.

3. Work on the two surveys has been done by different crews which leads to possible differences in interpretation of type specifications. Some changes have also been made in definitions; for example, the minimum volume for saw-timber stands has been lowered from 2,000 board feet (1936) to 1,500 board feet (currently). Furthermore, no board-foot volume is figured in aspen or hardwood trees below 11 inches d.b.h. at present, whereas 9 inches was the minimum diameter originally. On the other hand, because of improved markets, fewer trees are classified as culls and fewer areas are called noncommercial now than in 1936. Hardwood limbs were included in the original cubic-volume estimate but are excluded in the resurveys.

4. In the original survey, type proportions were based entirely upon interpretation of types on small sample plots, whereas current figures come from mapping. The former method leads to type purification while the latter encourages some generalization of condition classes.

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1/ The present survey also incorporates national forest area data based upon 100-percent mapping on areas within national forest boundaries.